

Presumably here, as in *Pilea* (see Jost, Plant Physiology, English Edit., 1907, p. 425), osmotic pressure tears an anther loose from the base of the stamen, the filament straightening with sufficient force to throw out the pollen. The staminate flowers are in a rather compact catkin and it is likely that the jar of one stamen straightening and bursting is enough to set off the other flowers; at any rate, examination of a catkin after an explosion shows generally that all of the flowers have been sprung and the pollen thrown out.

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## REVIEWS

### Knowlton's Mesozoic and Cenozoic Plants of America\*

Those who have had occasion to deal with American Cretaceous or Tertiary plants have long used and valued Dr. Knowlton's Catalogue published in 1898, which brought together the scattered records in the most convenient form. The new Catalogue, a work of 815 pages, enumerates all the Mesozoic and Cenozoic species, including, as Dr. Knowlton informs me, no less than 4,789 accepted forms. The fossil plants of Greenland and Mexico are excluded, but those of Alaska are fully cited. In its form and arrangement the new Catalogue resembles the old, but it differs in having a series of extremely useful appendices. The first of these gives the classification of all the genera in orders, families, etc.; the second an index of genera and families in the classification; the third enumerates the plants of each formation, from the Triassic to the Pleistocene. The amount of labor represented is enormous, but the saving to others is much greater. My annotated copy of the old list, and my imperfect attempts to cover the ground represented by the appendices, look rather pathetic by the side of this vastly more complete and satisfactory work. We can only hope that with this new aid the very small band of American paleobotanists will be

\* Knowlton, F. H., A Catalogue of the Mesozoic and Cenozoic Plants of North America, U. S. Geological Survey, Bulletin 696, 1919 (published early in 1920; received at Boulder, Feb. 18).

increased, so that eventually the whole subject will be adequately revised. This, however, will not occur until there are better publishing facilities, including means of presenting adequate illustrations. Thus, for example, under existing conditions it is futile to attempt to revise the Cretaceous plant remains accumulating in the University of Colorado, since no provision exists for the publication of a report. The Rocky Mountain Cretaceous strata are at present furnishing great quantities of oil and coal, and the volume of wealth produced is almost incredible. Yet no provision is made for a complete and systematic survey of the Cretaceous rocks and their fossils, and the prevailing ignorance leads to great waste and no little fraud, for all of which the public eventually has to pay. Scientific men, who should be conducting fundamental researches, are many of them induced to spend their time working for private companies, so that the general situation tends to get worse rather than better. The proper remedy would be to tax the oil and coal industries for the purpose of securing adequate funds for a continuous scientific survey of all the strata concerned and problems involved. Then young men and women of ability might be induced to devote their lives to research, knowing that they would have fair pay, opportunities for getting the work done, and would be rendering important services to their country. We may still believe that there are many who, under such conditions, would resist the temptation of the money bags.

It must not be supposed that Dr. Knowlton's Catalogue is of interest only to students of fossils. It should be in the possession of every botanist who cares anything about the wider aspects of his science. The lists of species by strata and localities will be especially instructive, and will tend to correct the impression produced by the combined list (as if of a single flora) given in Harshberger's great work on the distribution of American plants. It will be noticed that nearly all the genera of woody plants well represented today in North America also abounded during Tertiary times. The climate during at least the greater part of Tertiary time was evidently warmer than now, but aside from this, the genera were more widespread apparently independently

of climatic influences. Thus the tree flora of Florissant during the Miocene was rich in types now lacking in Colorado. Some of these, as *Ficus*, *Sequoia* and *Magnolia*, could not now exist in this region. Others, however, apparently could live well enough, and do so in cultivation. We thus see that the present flora is to be explained partly by present conditions, but largely also by those of the past, which led to the regional extermination of certain types. The ecologist who concerns himself only with the present is thus like a sociologist who should refuse to study history.

The question has often been raised, how far can we trust the determinations of the paleobotanists? Undoubtedly many of the generic references are erroneous; even Lesquereux, who was not only a great paleobotanist, but also a specialist in living mosses, described a fragment of a fossil conifer as a moss. Nevertheless, very much may be learned from the fossils, and there can be little doubt that on the whole things are pretty much what they seem to be. I believe that a closer study of the Tertiary fossils will throw much light on the origin of elements in the modern floras of North and South America, especially when the results of Dr. Berry's recent trip to the Andes are made available. Thus, it is very interesting to find abundant remains of apparently quite genuine Cunoniaceae (*Weinmannia*) and Proteaceae in the Rocky mountain Miocene. Whence came these southern types? I believe via Asia, rather than by way of South America. So also with *Porana*, an old-world type fossil at Florissant, but represented still by a stranded relic south of the Mexican boundary. So also with *Ailanthus*, *Libocedrus*, etc. Take up the genuinely neotropical flora, that which certainly originated in South America, and note the *absence* of innumerable striking types in our fossil floras. A good example is *Cecropia*, which has some 30 or 40 neotropical species to-day, and would be easily recognized.

Another problem is that of the herbaceous plants. A well-known naturalist wrote me the other day, discussing a problem of animal distribution on the supposition that the grass-like plants first became abundant and well developed in the Miocene.

It is certain that they were then much as they are to-day, with a very long history behind them. The very meager catalogue of monocotyledonous plants in Dr. Knowlton's work should convince any one that no dependence can be placed on the apparent absence of these organisms in particular beds. It is the same with the higher herbaceous plants. Only two genera of Compositæ are listed, both from the Florissant Miocene. One of these is thought by Knowlton to be erroneously identified, and although I was responsible for the determination, I now believe he is right. There are no Campanulales at all except at Florissant. Scrophulariaceæ are represented by a lone Florissant species. Who will maintain that these families did not abound during Tertiary time? Their present diversity and abundance prove that it must have been so. Thus the *absence* of herbaceous fossils proves nothing, though we can reason about the absence of trees which shed their leaves in abundance. Undoubtedly, more minute and critical studies will reveal a wealth of herbaceous fossils, at least as represented by flowers, fruits and seeds. I have many such from Florissant, but have set them aside hoping to make accurate generic determinations. Such remains as these strain one's knowledge of botany to the breaking point, but some day they will be deciphered. In a work of such scope, there will always be some errors and omissions, but in this case they seem to be astonishingly few. I found three species omitted, all involving genera not in the list. These are *Firmianites aterrimus* Ckll.,\* *Melica primæva* C. T. & Bierne B. Brues,† and *Xantholithes propheticus* Ward.‡ Dr. Knowlton writes me that *Coniospermites* should be *Conospermites*. *Hicoria antiquora* should be *antiquorum* (a genitive plural). *Carpolithes emarginatus* Perkins, from Vermont, is preoccupied by *C. emarginatus* Goep. (*Cardiocarpum emarginatum* Goep. & Berg.), and may be called *C. perkinsi* n.n. There are a few errors in the classification; thus *Thrinax* has somehow got into Araceæ, and *Hedera* into Vitaceæ.

\* Amer. Journ. Science, Nov., 1909, p. 447. (Eocene, Green R., Wyo.)

† Bull. Wisc. Nat. Hist. Soc., Oct., 1908 (received April, 1909), p. 171. (Miocene, Florissant, Colo.)

‡ Glimpses of the Cosmos, IV (1915), p. 150. (Laramie, Montana.)

In Journ. Washington Acad. Sciences, VI: 109 (1916) I described what purported to be a lower Cretaceous Flora in Colorado. The only species I definitely identified was *Matonidium althausii*, a well-known Lower Cretaceous fern. Some additional evidence came to light, and in view of the apparent complications it was thought well to refer the material to Dr. Berry, who published a very valuable article in Bull. Torrey Bot. Club, 46: 285. Berry concludes that the *Matonidium* is a distinct species, which he names *M. americanum*. With this decision I have no quarrel, but I call attention to the subject to illustrate an unfortunate tendency in paleontology to convert suggestions into positive statements in quotations. Berry states that my plants came from "the supposed McElmo," but I said the deposit was "above the McElmo." A fossil which Berry (no doubt correctly) considers to represent the apical part of a *Matonidium* stipe, I said closely resembled *Cycadospadix*. Berry says twice that I "referred" it to *Cycadospadix*. Knowlton, in his list on p. 732, cites from my paper without any query *Equisetum burchardti* and *Sapindopsis variabilis*, but in the main list a query is given with the latter. I said, "stems . . . may well represent the species *Equisetum burchardti*, but the sheaths are unfortunately wanting," and "leaves . . . may well belong to" *Sapindopsis variabilis*, "although the lateral veins appear to form a more acute angle with the midrib than in that species as figured by Berry." Berry thinks both suggested identifications are wrong, so my cautious language was justified. In nearly all paleobotanical work there is necessarily a considerable margin of error, so that when hesitation or doubt appears it should never be converted without investigation into apparent certainty.

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\* Brown, Nelson C., "Forest Products, Their Manufacture and Use," xix + 471 pages, frontispiece and 120 figures. John Wiley and Sons, New York, 1919. Net \$3.75.